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ABSTRACT

The comparative school readiness and cognitive ability of kindergarten children from lower-income schools (N=47) and from higher-income schools (N=71) were assessed using the Preschool Inventory and a battery of eight Piagetian tasks. The overall purpose of the study was to ascertain characteristics of the children's cognitive development as a basis for subsequent examination of kindergarten curriculum programs in the Paradise Valley Unified School District of Arizona. There was a concern within the District that differences in maturity, experience, and achievement might exist between children attending Title I schools and children attending schools not meeting the eligibility requirements for Title I. Results indicated that all children performed within the high range of normal scores on the Preschool Inventory. The lower-income group had a mean score of 54 (range, 28-64) and the higher-income group a mean score of 57 (range, 42-64). This difference, although statistically significant, was considered to be an artifact of measurement. For the measures of cognitive ability, the two groups' performances did not differ significantly on conservation, seriation, or spatial relationships tasks. The high-income group scored significantly higher than the lower-income group, however, on classification tasks. (Author/SS)

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PARADISE VALLEY UNIFIED SCHOOL DISTRICT

CURRICULUM RESEARCH STUDY:

PART 1

COGNITIVE DEVELOPMENT IN KINDERGARTEN CHILDREN

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Curriculum Research Study:

Cognitive Development in Kindergarten Children

Background

The Paradise Valley Unified School District is projecting a review of its reading curriculum during 1979-1980. As one phase of preparation for that review, it was decided to examine the thinking processes of a random sample of children drawn from the 43 kindergartens in the District. The overall purpose was to ascertain selected characteristics of the children's cognitive development as a basis for subsequent examination of kindergarten curriculum programs.

One concern within the District has to do with the possible differences in maturity, experience, and achievement which may exist between those children attending the cluster of 4 schools identified as meeting eligibility requirements for Title I funds and those children attending the cluster of 6 schools not meeting such eligibility requirements.

Another concern is a somewhat more complex, philosophical issue. This pertains to the efforts within the kindergarten program to achieve an appropriate balance among three competing components: (a) facilitation of healthy developmental growth in children in the areas of free, spontaneous social interactions, a personal sense of competency, and an all-round good physical fitness level with ample provisions for varied and energetic activity; (b) exposure to intellectual content which will match children's ability to understand and will promote their progression to more advanced stages in perceptual abilities, self-initiated actions, conceptualizations, and language understandings and skills; and (c) enhancement of behaviors thought to prepare

children in aptitudes and attitudes for the more formal schooling in the elementary grades, especially reading.

Rationale

The primary concerns of this study were with the nature of developmental differences of children from the two clusters of schools, and profiles of cognitive functioning of the children as a factor in determining program emphasis. It was decided to use both a standardized measure of educational achievement reflecting requirements of school success and a battery containing tasks designed to assess level of cognitive development.

The standardized measure, Preschool Inventory, Revised Edition (1970) was selected on the basis that the original Inventory and its ensuing revision had been used successfully in preschools and kindergartens since 1965 to determine the specific achievements a child brought with him to the educational experience. The Inventory had also yielded certain indications of the degree of difference in performance to be expected from children of various socioeconomic backgrounds.

Tasks similar to those in the Assessment Battery (1978), based on Piaget's developmental theory, had furnished evidence in the past that was considered practical for exploring the main concerns of this study. With respect to the first issue, that of diversity in the backgrounds of children at the various schools, the literature generally supports the influence of the home environment and socioeconomic status on early learning. Almy, Chittenden, and Miller (1966) using several measures of conservation, drawn from Piaget's theory, showed that while 48 percent of second-grade children in a middle-class

school were able to conserve on all three tasks presented, only 23% of children from the lower-class school succeeded at a comparable level. The delay had been evident in both their kindergarten and first grade results, as well. DeMeuron and Auerswald (1969) reported on similar tasks of conservation and several additional ones in classification. In their study of 57 children between ages 7 and 11 from a low-income, urban population, the thought processes remained at a preoperational, intuitive level for a significantly longer period than in the average child, a delay as much as three to four years. It was conceivable, therefore, that this Assessment Battery would help determine differences, if any, in cognitive development in children from the two school clusters.

With respect to the second issue, level of children's thinking as a basis for evaluating and planning kindergarten programs, there is considerable evidence that level of logical thinking bears a relationship to success in school attainment. The literature bearing specifically on symbolic representation and reading is summarized elsewhere (Raph, 1978). In brief, data from the study by Almy, Chittenden, and Miller (1966) demonstrated that logical thought is a significant factor in reading readiness, comprehension, and school achievement. Briggs and Elkind (1973) in a comparison of 16 matched pairs of five-year olds, readers and nonreaders, similarly identified conservation level as differentiating between the two.

Elkind who has done a series of studies on the relationship of perceptual activity to the reading process (1962, 1967, 1969, 1974) theorizes as a result of his work that there are four requirements for beginning reading: (a) a language rich environment; (b) attachment to adults who model and reward reading

behavior; (c) the attainment of concrete operations; and (d) an instructional program. One aspect of this investigation, then was to chart the progression toward concrete operations.

Procedures

Sample

A random sample of children in the Paradise Valley kindergarten classes (N=118) was selected for this study. One group of children (N=47) attended the cluster of 4 schools identified as meeting eligibility requirements for Title I funds, referred to in this report as lower-income schools (LI). The other group of children (N=71) attended the cluster of 6 schools not meeting such eligibility requirements, referred to here as higher-income schools (HI).

Measures

The standardized measure, Preschool Inventory, Revised (1970) was designed for individual use with children in the age range of three - to six-years. It was developed to give a measure of achievement in areas regarded as necessary for success in school, namely Personal-Social Responsiveness; Associative Vocabulary; Concept Activation-Numerica; and Concept Activation-Sensory. One aim of the Inventory was to provide educators with an instrument that would permit them to highlight the degree of disadvantage which a child from a deprived background has at the time of entering school, and would reflect the child's previous experiences. This Inventory was administered individually by the kindergarten teachers.

The battery of eight Piagetian tasks (Assessment Battery, 1978) was assembled to obtain information about the level and characteristics of reasoning in the kindergarten Subjects. Unlike the standardized measure, the scores

obtained on these reasoning tasks do not lend themselves to normative comparisons. However, the scores do suggest how children perceive their world when confronted with manipulative tasks, how they interact with materials, and how they conceptualize solutions to the problems posed. A Guide to Tasks is included in this report. The Assessment Battery was administered by an examining team of five trained individuals.

Results and Discussion

Preschool Inventory, Revised

Results. The total random sample of children drawn from the kindergarten classes (N=118) had a mean age of 5.5. On the Preschool Inventory their mean score was 56 out of a possible total of 64 (Table 1). Scores ranged from 28 - 64 with a Standard Deviation of 5.6. This placed Subjects at the 96th Mid-Percentile Rank, indicating that the group as a whole scored in the high range of normal on this educational test.

The Lower-income group (N=47) had a mean age of 5.5 with a mean score of 54, a range of 28 - 64, and a Standard Deviation of 7. This placed LI Subjects at the 93rd Mid-Percentile Rank. The Higher-income (N=71) had a mean age of 5.4 with a mean score of 57, a range of 42 - 64, and a Standard Deviation of 4. This placed them at the Mid-Percentile Rank of 97 (Table 1).

A t-test of the differences between the two groups (HI and LI) was significant at the .01 level of confidence on the Inventory favoring the HI group (Table 6) suggesting that children attending the 6 cluster schools where income is higher performed at a level superior to children attending the 4 cluster schools where income level was lower.

Discussion. It is apparent from the results on the Preschool Inventory that the total group of children in the random sample are performing within the high range of normal on this measure. The measure, selected because of its wide use and its norms which differentiate on the basis of socioeconomic status, did however, lack a sufficiently high ceiling to tap more fully the attainments of this group of children.

Although there was a significant difference between the scores of the HI and LI groups, this difference is considered to be more an artifact of measurement than an indicator of any marked difference between the two groups. An inspection of Table 1 shows that both groups performed at a relatively comparable high level. Note should be made, also of the fact that there were low and high scorers among both groups of children.

Finally, it is of value to consider the nature of the items on this measure. The Inventory requires naming, labeling, following directions, and general familiarity with common objects, colors, shapes, and numbers. While such knowledge of attributes is a basic requirement for further use, it is, in another sense, merely the organization of sensory data. What is critical and is not revealed on this measure is the child's ability to transform knowledge into actions involving reasoning. That is, to what extent do children utilize their available information in their individual and small group activities when confronted with problems offering opportunity for exploration, trial and error, comparisons, predictions, and alternative solutions.

Assessment Battery

This summary organizes the eight tasks administered into four main categories: (a) Classification; (b) Conservation; (c) Seriation; and (d) Spatial Relationships. Analysis is directed to indicating what differences,

if any existed between children drawn from the two school clusters. The level of reasoning of the total group, as well, will be reported.

Results: Classification. On the two tasks involved here, Classification and Class Inclusion, the children from the HI schools were more successful than those from the LI schools, significant at the .01 level of confidence (Table 6). Success on these tasks was also significantly related (.01) to success on the Preschool Inventory.

For the group as a whole 28% Passed, 40% were In Transition, and 32% were scored as Not Passing (Table 2).

Discussion: Classification. Certain unique features of these two tasks may be related to the differences shown between the two groups of children. In the first one, Classification, children are required to construct their own criteria mentally when confronted with a miscellaneous assortment of objects and invited to "put together what goes together." Had the children been told to place together the large and small objects, or the red and blue ones, most of them could have performed the assignment with ease. However, here the children were required to abstract independently from the array of objects placed before them a characteristic of similarity, then arrange the objects accordingly, and subsequently determine a different criterion for resorting the same objects. This requires a higher level of thinking than following directions. The child is also expected to be able to verbalize his criteria. Piaget speaks of a self-regulatory mechanism wherein a child can spontaneously transform his knowledge of likenesses and differences into actions, in this instance, groupings.

The results above might be accounted for by such factors as parental

encouragement, opportunity for initiative, access to manipulative materials, reliance on the child to search for his own solutions to problems.

In the second task in Classification, Class Inclusion, where an ability to coordinate sets and subsets is required, children 5 - 6 are only beginning to identify one set (or group). They will require maturing and many experiences with objects before they can begin to relate subsets to each other and subsets to a larger set. Although it is a more advanced task, it is a necessary component of the child's understanding of groupings. The small percentage who were scored Passing suggest the difficulty of the concept for children this age, regardless of background.

Conservation: Results. On the three Conservation tasks, Number, Mass, and Volume, children from the HI schools did not differ from children attending the LI schools. Overall, these tasks were the most difficult of the four categories. There is evidence (Table 2) that children are beginning to conserve Numbers (16%), while conservation of Mass (10%) and of Volume (8%) is following at a slower rate.

Conservation: Discussion. The order of children's acquisition of conservation -- Number, Mass, and Volume, follows the classic studies in this area as to sequence of acquisition and timing, as well. The majority of children fully acquire the landmark of conservation around 7 years, or later. Conservation permits the child to maintain a characteristic of an attribute (number, amount, length, etc.) as stable during physical changes of some aspect.

The question of how the concept of conservation is attained is one that is still being debated (Wallach, 1968). Certain factors have been identified. given the basis of sensory experience. These include (a) social transmission of information; (b) ability to think in certain ways - i.e. thinking of different yet equivalent units; thinking of several aspects of a situation at the same time; thinking of operations as reversible; (c) differentiation; (d) reduction of stimulus dependence; (e) inference from the absence of addition and subtraction; and (f) reversibility. These factors constitute a formidable array, it is granted, and one not directly taught. It may be appropriate to term the achievement of conservation "a happening."

It is safe to assume that what may be most significant in the child's acquisition of conservation depends on the wealth and variation of his manipulative opportunities -- frequent pouring, mixing, transferring, comparing, adding and taking away of clay, dough, water, sand, etc. -- activities children rarely tire of -- each activity renewed in interest by the addition of all possible types of containers, -- different in size, shape, color, and use. Similarly block play also lends itself to a child's understanding of conservation. Other added ingredients to appropriate preconservation activities would be experiences in transformations -- having the child draw a picture of a block edifice he had built; construction of block patterns according to a plan or design; transforming a picture into a design or a design into a picture; drawing a picture of a clay object the child has constructed, or modeling a clay object from a picture, etc. Also, essential would be time for individual and small group activities where challenging concrete materials spark excitement, puzzlement, variations, and construction of all kinds. A flow of language while the activities is going on may be helpful, although

children require silent times, too, for thinking. Planning verbally what is to take place is a channel of mental growth, as well as reconstructing in language what the child has accomplished, and more importantly how he accomplished it.

Seriation: Results. Ability of children to order a series of rods according to length did not differ between the group of children drawn from the LI cluster schools and the HI cluster schools. There was a significant relationship between a child's success on this task and his score on the Preschool Inventory suggesting that the Seriation task and the Inventory task tap a child's ability to organize sequentially as well as to recognize inter-relationships between and among the length of objects.

For the group as a whole 38% Passed. 13% were In Transition and 49% were scored as Not Passing (Table 2).

Seriation: Discussion. Although this was the second easiest task of the eight presented (Table 2), almost half of the children from both groups were unable to complete it successfully. One difficulty children had was dealing with the whole group of ten rods to be ordered. Some would group two or three rods at one end, and two or three at the other end, but were unable to construct an array which combined the two groups, an indication that children need many concrete experiences with combining objects, ordering them as to length, height, weight, breaking them into subgroups, and reforming them into larger, total groups.

Spatial Relationships: Results. On the two tasks in this category, Right-Left Orientation and Reverse-Linear Ordering, performance did not differ between the groups of children from the two cluster schools. Reverse-Linear Ordering proved to be the easiest among the eight tasks with respect to percent-

age Passed for the group as a whole. Fifty-five percent Passed and 45% were scored as Not Passing (This task was only scored for total success, there were no intermediate levels identified.) On Right-Left Orientation 18% Passed. 82% were scored Not Passing. (Table 2).

Spatial Relationships: Discussion. These two measures were introduced not only because they form part of the network of logical thought, but also because the concepts of right-left and mobility in thinking which permit a child to reverse ideas (If we changed the first person in the line to the last, but we wanted the line to be just the same, how would we do that?) are necessary components of a number of school attainment tasks. The Reverse-Linear ordering task involves proximity of blocks to be ordered. Proximity expresses the most fundamental characteristics by which an individual generates notion of space. In the case of a linear series, proximity between separate elements is sufficient to provide for a relation of order.

A possible reason for some Subjects having difficulty in ordering a linear series might be that the synthesis of the promimities is dependent on the choice of an initial fixed order of succession and a fixed order can only be maintained by coordinating the proximities between the different elements.

Conclusions

A number of inferences and suggestions regarding the findings of this research were included in the discussion of the preceeding sections of the report.

Those of us who planned, administered, and analyzed the results are aware, as the readers will be, of the limitations of making generalizations from a random sample. Our results do not permit conclusions regarding in-

dividual children. Certain critical factors and influences have not been considered such as physical maturation, ability to attend to a task, home orientation toward learning, emotional stability, social competency, and language facility, all of which are related to a child's cognitive functioning. Valuable insights of teacher observations could not be included.

We are also aware of the shortcomings of most educational and cognitive measures of children five to six years of age. Apart from the considerations of validity and reliability there is the tenuousness of interpreting outcomes when only a very small sample of behavior of each child was observed and measured.

In regard to the two areas of concern which prompted this study, we can attempt certain conclusions which may be helpful.

Comparison of Cluster Schools

It does not appear, overall, that there are marked differences between the children from the two school clusters. Examination of the data wherein a significant difference on the Preschool Inventory is shown favoring children from the higher income schools does not show children from the lower income schools lagging very far behind. An interesting observation of one of the trends seen by a team member points to the fact that a larger number of children from the LI schools responded to items on the Inventory by saying "I don't know," instead of giving a wrong answer. These may be the children who, as they get older, respond to queries on individual tests by saying, "I haven't had that in school yet," both answers indicating a possible lack of individual initative and confidence in tackling a new problem or experience, or trying out alternatives. One 5 year old child, on the way to the testing

room said apprehensively, "I'm not good at hard questions."

There have been consistent findings in the research literature that suggest children's cognitive development is influenced by home environment and socioeconomic status, and that a delay in cognitive development ensues when these factors are not favorable. Numbers of these studies were conducted in urban, inner-city settings where ethnic and racial minority status compounded the problems associated with low income. It could be argued that in the Paradise Valley district the environments are not sufficiently disparate or disadvantaged to make a difference.

If, however, one compares performance of Subjects in the cluster schools, there appears to be some tendency for the lower-income schools to rank lower than the higher income schools on the Assessment Battery. On the basis of percentage of tasks Passed by the children as a basis for ranking, three of the four LI schools are in the lower half. (Table 4). If percentage of tasks Passed is combined with In Transition status (wherein the child is showing some beginning indications of understanding the concepts being measured) three of the four LI schools are again in the bottom half. (Table 4). This In Transition status may be a reflection of the progress children are now making during attendance in kindergarten, but this is only a speculation.

Profiles of Cognitive Development

The functioning of the children on the tasks of logical reasoning point to additional conclusions. Because children ranked as high as they did on the standardized measure of educational attainment and would seem to come from backgrounds that are either highly favorable at best, or not exceedingly dis-

advantaged at worst, one might be led to think that they will be as advanced in level of logical thought. For the group as a whole this did not prove to be the case. It could be said that "development will out...," that children are progressing at a rate to be expected for most normal children.

Tables 2, 3, and 4, show that the children are in the process of constructing their abilities to understand, represent their world symbolically, and to reason logically on the eight tasks presented to them. About one third of the children (32%) are still preoperational, that is, they are egocentric, reason intuitively, and respond on a simple, perceptual basis. 65% are In Transition on the tasks, moving toward the characteristics of concrete operations. (These will include reversibility which allows the child to reverse an action which previously was done only physically; ability to hold two or more variables constant at a time when studying objects (as length and thickness); presence of awareness of the views of others; ability to conserve certain properties of objects across changes in other properties; and ability to do relational thinking such as classifying and ordering objects.) To what extent the children will achieve this level which comes about slowly and unevenly, usually, in the first two or three grades of school, is of course, not known. It will occur, in part, as a function of their individual maturation, the opportunities for social exchange with adults and other children, and in-school and out-of-school experiences which offer them chances to advance to higher levels in their reasoning.

As indicated in the review of studies pertaining to reading (Raph, 1978), kindergarten teachers want what is best for their children. They are concerned with promoting readiness in its best sense, either generally in a developmental-type curriculum, or more specifically, in a structured one. The picture of the

Paradise Valley kindergarten children with regard to logical thinking (Table 2) indicates the tasks on which they reason at a higher level (Reverse Linear Ordering, Groupings, and Seriation). Except for the first one, however, more than half of the children on those tasks and an even larger number on the remaining five tasks have not as yet developed the structures necessary to deal with the concepts. This is not regarded in deficit terms by any means. Rather it is seen as developmental progression.

Within those findings (Table 5) note, also the wide variability among the children where no child succeeded on all 8 tasks, 10 children succeeded on 5 or more, and a range of from 11 - 37 children succeeded on 4 tasks or less, with 20 children unable to handle a single concept. This individual variability among the children, with some being clearly more mature and knowledgeable than others in both the HI and LI groups, and others being less advanced, means that individualization of programs appears to be a key need.

It might seem more straight forward and comfortable for teachers of whatever philosphical persuasion to view this study as diagnostic and proceed in some definite, programmed way to promote learning where there are lacks, i.e., to teach to the task. Such an option would be contrary to the developmental theory of Piaget. A more appropriate option would be for kindergarten teachers to think about their own thinking in relation to children's thinking. They need to ask themselves how they are facilitating appropriate opportunities for cognitive development in terms of individualization, organization of ideas and objects, language interactions, and emphasis on perception, actions, and conceptualization.

Duckworth (1978) in a recent article discussing the dilemma of applying Piaget suggests the path to follow, as she sees it.

....while we want each child to have the occasion to work at his or her own level, the solution is not to tailor-make exercises for each child. It is, rather to be sure that we offer situations in which children at various levels, whatever their structures, can come to know parts of the world in new ways. This is the burden for educators. It is not an easy job, but how much more interesting a human enterprise it is...

Practical situations which are the ones that correspond most to children's natural activity are not only sufficient, but are also the best kinds of learning situations. In the course of trying to solve practical problems, children spend time re-organizing their level or understanding; in the context of real situations, children develop multiple access routes to their knowledge. A learning situation in school need not -- and should not -- be different from children's natural form of learning about the world. We need only broaden their scope -- open up parts of the world that children may not, on their own, have thought of thinking about. (p.7).

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Table 1

Comparison of Preschool Inventory Scores

Group	N	Mean Age	Total Score	Range	S.D.	Mid-Percentile Rank
Lower Income	47	5.5	54	28-64	7	93
Higher Income	71	5.4	57	42-64	4	97
Total Sample	118	5.5	56	28-64	5.6	96

Note: Maximum score = 64

Table 2

Comparison of Three Levels of Functioning of the Total Sample on Assessment Battery

	Not Passed	In Transition	Passed
1. Classification			
Grouping	20%	36%	44%
Class Inclusion	43%	44%	13%
TOTAL	32%	40%	28%
2. Conservation			
Number	66%	18%	16%
Mass	78%	12%	10%
Volume	90%	2%	8%
TOTAL	79%	10%	11%
3. Seriation	49%	13%	38%
4. Spatial Relationship			
Rt-Lft	82%		18%
Reverse-Linear	45%		55%
TOTAL	64%		36%

Table 3

Comparison of Level of Performance
(Piagetian Stages) on Assessment Battery
According to Income Cluster Schools

HI Schools	N	Piagetian Stages				
		Preoperational	Transitional			Concrete Operational
			1	2	3	
Desert Cove	10	2 20%	4 40%	3 30%	1 10%	0 0
Desert Shadows	13	7 54%	3 23%	2 15%	0 0	1 7%
Larkspur	10	2 20%	2 20%	4 40%	1 10%	1 10%
Liberty	10	2 20%	5 50%	3 30%	0 0	0 0
Mercury Mine	11	4 36%	4 36%	2 18%	1 9%	0 0
Roadrunner	17	6 36%	8 47%	1 6%	0 0	2 12%
Sub-total	71	23	26	15	3	4
%		32%	37%	21%	4	5
LI Schools						
Arrowhead	14	5 36%	6 42%	3 21%	0 0	0 0
Campo Bello	10	3 30%	3 30%	4 40%	0 0	0 0
Cholla	10	4 40%	3 30%	3 30%	0 0	0 0
Palomino	13	3 23%	3 23%	6 46%	1 8%	0 0
Sub-total	47	15	15	16	1	0
%		32%	32%	34%	2%	0

Table 4

Comparison of Performance
(Not Passed, In Transition, Passed)
on Tasks in Assessment Battery
According to Income Cluster Schools

		Percentage of Tasks		
HI Schools	N	Not Passed	In Transition	Passed
Desert Cove	10	55%	22%	23%
Desert Shadows	13	65%	14%	21%
Larkspur	10	45%	18%	37%
Liberty	10	56%	13%	31%
Mercury Mine	11	66%	8%	26%
Roadrunner	17	60%	13%	27%
Total		58%	15%	28%
LI Schools				
Arrowhead	14	67%	14%	18%
Campo Bello	10	68%	11%	21%
Cholla	10	66%	8%	26%
Palomino	13	53%	26%	21%
Total		64%	15%	22%

Table 5

Total Number of Assessment Battery Tasks
Passed by Individual Children

Number of Children	Number of Tasks Passed
0	8
4	7
1	6
5	5
11	4
16	3
24	2
37	1
20	0

Total Number of Tasks = 8

Table 6

Comparison of Mean Scores on
Preschool Inventory and Assessment Battery
of Lower- and Higher-Income Groups

	Mean Lower-Income[1]	Mean Higher-Income[2]	t-value
Preschool Inventory Total Correct	53.9	56.9	-2.63*
Classification			
Grouping	1.13	1.27	-1.00
Class Inclusion	.49	.69	-1.53
TOTAL	.62	.92	-2.63*
Conservation			
Number	.40	.54	- .94
Mass	.21	.39	-1.60
Volume	.15	.18	- .34
TOTAL	.23	.37	-1.21
Seriation	.87	.90	- .16
Spatial Relationship			
Rt-Lft	.38	.34	.31
Reverse-Linear	.98	1.1	- .71
TOTAL	.68	.73	- .40

1 N = 47

2 N = 71

* .01 level of significance

Curriculum Research Study: Kindergartens
Paradise Valley School District
Fall, 1978

Demonstration: Piagetian Tasks

Guide to Tasks

These eight tasks are designed to reveal, in part, not what children still have to learn, but to reflect how children reason, how they organize relationships in their thinking. The task responses are influenced by children's maturation, previous experiences, social interactions, and by what Piaget refers to as a regulatory factor that unifies the other three influences, keeps them in balance.

(In Brief--)
Comprehension of the idea of common qualities -- what belongs together; ability to center on one idea at a time; ability to shift from one concept to a different one.

1. Classification. Many, if not most kindergarten children, if directed verbally, would be able to group blocks together "of the same color," "of the same size," and "of the same shape." This task in the battery, however, requires a child to think "independently," to identify a criterion he has available to him and then to center on that one criterion without forgetting it while he performs the grouping. He then must be able to let go of that idea, and identify a second criterion, and subsequently, a third one. This task then taps a child's understanding of the groupings; a child's ability to construct a group while keeping in mind the criterion from which he is working; and the child's ability to be sufficiently flexible mentally to shift from one criterion to a different one.

   To Pass, the child must be able to group successfully according to two criteria (and to have furnished these criteria himself).

Understanding of the stability of an objective attribute regardless of apparent changes.

2. Conservation of Mass. Child needs to understand that amount (mass) remains the same in spite of physical changes of some aspects,"an internal system of regulations that can compensate internally for external changes.

   To Pass, the child must conserve amount on both tasks (hot dog and sausage transformations) and give at least one of three possible explanations (a) nothing added, nothing taken away; (b) change in one dimension (longer) is compensated for by change in another dimension (thinner), hot dog; and (c) mass can be restored to the original size (inversion or reversibility).

3. Seriation. Child needs to be able to order rods from longest to shortest, succesively, requiring him to compare each rod with one longer and one shorter, and, in this instance, to insert two additional rods in the proper places.

To Pass, the child must have sequential alignment and insertions correct.

Use of a systematic method consisting of first looking for the longest or shortest element, then looking for the next one, etc., a method called "operatory" by Piaget..showing that a child understands that a given stick B is simultaneously bigger than the previous one A and smaller than the next one, B.

4. Conservation of Volume. Child needs to understand that volume remains the same in the task in spite of physical changes in size of containers used.

To Pass, the child must correctly answer the three transformations (from identical containers into a tall, thin one; and from identical containers into four small containers, and give one of the three possible reasons as in 2 a, b, & c.

Understanding of the stability of an objective attribute regardless of apparent changes.

5. Right-Left Orientation. Child needs to be able to place himself spatially in the position of the individual opposite to him, identifying that individual's right and left hands when crossed and recrossed.

Conscious awareness or mental discrimination between different viewpoints

6. Classification: Class Inclusion. Child needs to understand whole-part relationships, or supraordinate and subordinate classes, or sets and subsets. Operationally grasps the notion of "all," and "some."

To Pass, a child must give correct answer to all three of the questions in the task.

Regulatory control in thinking of the terms, "one," "some," & "all,"..mobility in thinking permitting movement between and among total classes & sub-classes.

Understanding of the stability of an objective attribute regardless of apparent changes.	7. Conservation of Number. Child needs to understand that number (eight) remains the same in spite of the physical changes in the array, from matching rows with small spaces between chips to a clustered group to a row with wide spaces between. To Pass, child must correctly answer the queries regarding the two transformations (into a cluster and into a widely spaced row) and give one of the three possible explanations as in 2a, b, & c.
Ability to perform a given action in a reversed direction. Is considered the main criterion of an operational structure. Its two chief forms in logic are negation (not male=female) and reciprocity (not better=worse)	8. Reverse-Linear Ordering. Child needs to coordinate two perspective viewpoints -- the more familiar direct order and the opposite or reversed order. This requires what Piaget terms a reversible operation wherein a child sees order between members of a series as a part of a unified whole and is consequently able to reconstruct a series just as easily in one direction as another. If the child reasons transductively, from one isolated element to the next, he will have difficulty re-ordering. To Pass, child must construct the sequence in reverse without an error.

To illustrate the difference that exists between learning and development, Piaget states: "I would like to make clear the difference between two problems: The problem of development in general, and the problem of learning. I think these problems are very different, although some people do not make this distinction. The development of knowledge is a spontaneous process, tied to the whole process of embryogenesis. Embryogenesis concerns the development of the body, but it concerns as well the development of the nervous system and the development of mental functions...In other words, development is a process which concerns the totality of the structure of knowledge.

Learning presents the opposite case. In general, learning is provoked by situations--provoked by a psychological experimenter; or by a teacher with respect to some didactic point; or by an internal situation. It is provoked, in general, as opposed to spontaneous. In addition, it is a limited process--limited to a single problem or to a single structure." [1]

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[1] Quote in G. Voyat. The development of operations: A theoretical and practical matter. In M. Schwebel & J. Raph (Eds.), Piaget in the Classroom. NY: Basic Books, 1973, 155-172.

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